APPRENTICESHIP TRAINING

COMMUNICATION ELECTRICIAN Program

Switching Craft

Alberta
MANPOWER
Apprenticeship and Trade
Certification Division

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COMMUNICATION ELECTRICIAN TRADE

THE GOAL OF APPRENTICESHIP TRAINING

To develop a competent tradesman who, through skill and knowledge, is capable of installation, diagnosis and repair of equipment as used in the Switching Craft of the Telecommunication Industry.

THE PRODUCT OF APPRENTICESHIP—
a graduate who will:

* have a thorough knowledge of electrical and electronic theory and its application to communication and associated equipment used in the Switching Craft of the Telecommunication Industry.

* be competent in the use of test instruments and understand their capabilities and limitations.

* have the dexterity and skill to carry out the mechanical functions of completing repairs.

* be familiar with the different circuit combinations and components.

* be capable of utilizing test procedures to locate faults and isolate defective components.

* understand the relationship and acquire appreciation of principles and concepts as applied to equipment in various craft areas of the trade.

COMMUNICATION ELECTRICIAN — SWITCHING CRAFT APPRENTICESHIP INFORMATION

Basic Requirements:

* Indenture for four periods of Trade experience.

* Attend a six week technical training course in the first, second, third and fourth periods.

* Fulfill the requirements for each period including 1800 hours of work experience inclusive of time spent at the training course; successfully complete the technical training course and obtain a satisfactory employer's report.

* Education — a minimum requirement is the completion of grade 11 with Mathematics 20 or its equivalent, or a pass on an equivalent entrance examination as prescribed by the trade regulation.

* Age — the minimum age for apprentices is 16 years. There is no upper age limit.

Credits:

* Accelerated patterns of apprenticeship may be granted for related technical training and/or experience.

Benefits:

* Apprenticeship is a learning-while-earning program. During the apprenticeship period, while working at the trade, apprentices are assured by regulation of a minimum percentage of the prevailing journeyman rate: 40% during the first period, 50% during the second period, 60% during the third period, 75% during the fourth period. Progress from one rate to the next takes place only after successful completion of all the requirements for each period (details are outlined in the Record Book).

* All apprentices 17 years of age and older are normally eligible for training allowances while attending technical training courses. These allowances are funded by the Canada Employment and Immigration Commission.

* Administrative procedures establishing the amount of training allowance is complex and can vary with an individual's circumstances. Contact a local Canada Employment Centre for details.

* An apprentice who successfully completes the program will graduate with an Alberta Completion of Apprenticeship Certificate and a Certificate of Proficiency.

* The most significant benefit to the graduate apprentice is that he is well trained in technical and practical aspects of the trade and is able to make a worthwhile and productive contribution to society. Society in return, will provide an opportunity for an above average income and successful livelihood.

DIRECTIONS FOR PROSPECTIVE APPRENTICES

* Contact your nearest Apprenticeship and Trade Certification Division for detailed information and counselling (see list of offices on page 44).

* Obtain an application form from the Apprenticeship and Trade Certification Division and neatly complete, in full, the information requested of the apprentice.

* Persevere in the search for apprentice employment and upon obtaining employment, give the application to the employer. It should be completed and returned to the Apprenticeship and Trade Certification Division forthwith.

*Any time credit, for previous experience in the Communication Electrician trade, should be discussed with the employer and requested on the application form by the employer.

* Attach to the apprentice application a copy (transcript) of the marks for your last year of school. Applicants who do not have their school transcripts or a grade eleven standing are required to write an entrance examination. If transcripts have been lost, contact Alberta Education for information on school transcripts.

* Prepare to be called for an entrance examination following submission of your application. You will be advised of the date, time and location.

* A contract of apprenticeship is entered into between the apprentice and the employer and should be signed within 90 days after the apprentice application has been approved. If contracts have not been issued within this time, contact the Apprenticeship and Trade Certification Division.

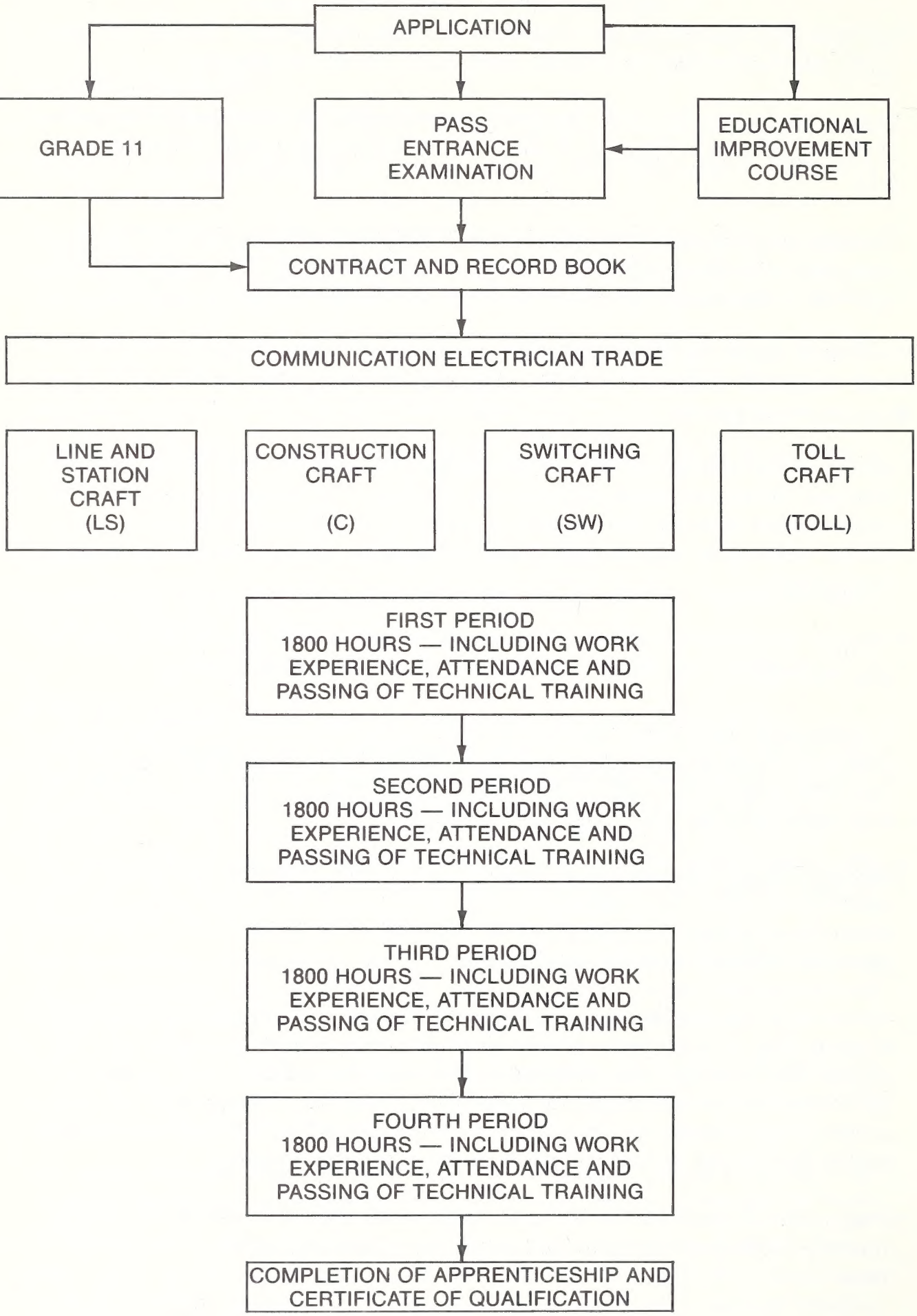
* Before signing the contract of apprenticeship read the complete document carefully — know your obligations and responsibilities to your employer — know the employer's obligations and responsibilities to you — feel confident you have selected the right occupation.

* Know when you will be expected to attend classes and be prepared to attend. In early May of each year, School Schedules are sent to you and your employer. The employer also receives a class selection card for you, which is to be completed and submitted for scheduling. Information on procedures also accompanies the above. Confirmation on the date you actually get scheduled and/or the Official Notice will follow at the appropriate time(s).

* Prepare in advance for the financial obligations required of you during school training. Reference materials and school supplies are paid for by the apprentice.

* While an apprentice, it will be your responsibility to respond promptly to mailed directions and requests from the Apprenticeship and Trade Certification Division.

APPRENTICESHIP ROUTE TOWARD CERTIFICATION



APPRENTICESHIP COMMITTEE STRUCTURE

Communication Electrician Provincial Apprenticeship Committee

The Provincial Apprenticeship Committee for the Communication Electrician Trade is comprised of members from Local Apprenticeship Committees from the cities of Edmonton and Calgary.

This Committee is concerned with the policies that guide the program and make recommendations to the Apprenticeship and Trade Certification Board and the Executive Director of the Apprenticeship and Trade Certification Division in the following areas:

* Contribute current information relative to changes in the trade and requirements of industry.

* Make recommendations for changes to existing trade regulations.

* Assist in updating of the training program through recommendations for revisions to the course outline and attendant examinations.

* Naming personnel to Technical Advisory Committees.

Communication Electrician Local Apprenticeship Committee

Local Apprenticeship Committees are concerned with individuals and trade situations within a local region. Meetings are held throughout the year to make recommendations and to discuss problems relating to the apprenticeship program. Members who serve on committees are nominated by employer and labour organizations, and membership is equally divided into employer and employee representation in accordance with The Manpower Development Act.

Apprenticeship Committee Members:

Mr. D. Ashton — Calgary — Employee
Mr. R. Flack — Calgary — Employee
Mr. C. Barry — Edmonton — Employer
Mr. R. Hoy — Edmonton — Employer
Mr. L. Kelly — Edmonton — Employee
Mr. A. Hayduk — Edmonton — Employer
Mr. M. Grabia — Edmonton — Employee
Mr. R. Graff — Edmonton — Employer
Mr. W. Robbins — Edmonton — Employer (Alternate)

COMMUNICATION ELECTRICIAN PROGRAM
SWITCHING CRAFT
COURSE OUTLINE

This outline has been prepared in accordance with recommendations from the Provincial Apprenticeship Committee for the Communication Electrician Trade in the Province of Alberta.

The outline was updated following consideration given to recommendations and suggestions from:

Local Apprenticeship Committees
Representatives from training institutes
Curriculum Sub-Committee of the Provincial Apprenticeship Committee
The Technical Advisory Committee

PROCEDURES FOR RECOMMENDING REVISION(S) TO THE COURSE OUTLINE

Any concerned citizen or group in the Province of Alberta may make recommendations for change by writing to the Apprenticeship and Trade Certification Division, Edmonton.

It is requested that recommendations for change refer to specific areas and state references used. Recommendations received will be placed before regular meetings of the Provincial Apprenticeship Committee.

SAFETY EDUCATION

Safe working procedures and conditions, accident prevention and the preservation of health is of primary importance in the Apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of the government, employers, employees and the general public. Therefore, it is imperative that all parties become aware of circumstances that may lead to injury or harm and that safe learning experiences and environment can be created by controlling the variables and behaviors that may contribute to or cause an accident and/or an injury.

It is generally recognized that a safe attitude contributes to an accident free environment. As a result a healthy safe attitude towards accident prevention will benefit an employee by helping to avoid injury, loss of time and loss of pay.

A tradesman is possibly exposed to more hazards than any other person in the work force and therefore, should be familiar with the Occupational Health and Safety Act and Regulations dealing with his own personal safety and the special safety rules applying to each job.

LEGAL AND ADMINISTRATIVE ASPECTS

Employer's Responsibilities:

Accident prevention and the provisions of safe working conditions are the responsibilities of an employer. The company is responsible for:

1. The provision and maintenance of safety equipment
2. The provision of protective devices and clothing (as required by the Occupational Health & Safety Act, General Safety Regulations)
3. The enforcement of safe working procedures
4. Adequate safeguards for machinery, equipment and tools
5. Observance of all accident prevention regulations
6. Adequate training to allow a worker to use or operate equipment in an effective and safe manner.

Government's Responsibilities:

The Apprenticeship and Trade Certification Division in conjunction with the respective Provincial Apprenticeship Committee assumes the responsibility to assure that adequate safety is reflected in the curriculum and that adequate safety instruction is presented at the training establishments.

The Occupational Health and Safety Inspection Branch assumes the responsibility for periodic inspection of the operation to ensure that regulations for industry are being correctly observed.

Individual's Responsibilities:

The employee is responsible for:

1. Knowing and working in accordance with the safety regulations pertaining to job environment and
2. Working in such a way as not to endanger himself or his fellow employees

The major factor in safety is the individual employee, his personal attitude toward safety and having an awareness of the respective safety regulation.

SWITCHING CRAFT PROGRAM

Subjects and Time Distribution

First Period	6 Weeks	30 Hours Per Week	180 Hours	Page
Section One:	Basic Electricity — Theory		84	9
Section Two:	Basic Electricity — Lab		54	15
Section Three:	Trade Mathematics		42	18
Second Period	**6 Weeks**	**30 Hours Per Week**	**180 Hours**	**Page**
Section One:	Electronic Theory		54	21
Section Two:	Electronic Lab		18	23
Section Three:	Basic Telephone Theory and Lab		54	24
Section Four:	Logic Theory and Lab		54	27
Third Period	**6 Weeks**	**30 Hours Per Week**	**180 Hours**	**Page**
Section One:	Microprocessor and Minicomputer Concepts		72	30
Section Two:	Common Control Principles		108	32
Fourth Period	**6 Weeks**	**30 Hours Per Week**	**180 Hours**	**Page**
Section One:	Transmission — Theory and Lab		54	34
Section Two:	Advanced Switching — Theory and Lab		126	37

FIRST PERIOD TECHNICAL TRAINING

SECTION ONE: BASIC ELECTRICITY — THEORY — 84 Hours

A. Fundamental Concepts of Electricity

1. Introduction to electricity
   (a) development
   (b) fundamental concepts and application
   (c) components
   (d) terminology
2. Negative and positive polarities
3. Electrons and protons in atoms
4. Unit of charge — coulomb
5. Unit of potential — volt
6. Charge in motion — current
7. Opposition to current — resistance
8. Conductance
9. Closed circuit
10. Sources of electricity

B. Ohm's Law — 2 Hours

1. Definition in terms of E, I and R
2. Relationship of E, I and R to solve problems
3. Power and power dissipation in resistance
4. Multiple and submultiple units
5. Electric shock

C. DC Circuits — 4 Hours

1. Series
   (a) current
   (b) resistance
   (c) voltage drops
   (d) power in series circuit
   (e) equivalent circuits
   (f) analysis
   (g) effects of open and short circuits
2. Parallel
   (a) common voltage
   (b) branch currents
   (c) total current

(d) total resistance
(e) conductance in parallel
(f) power in parallel circuits
(g) drawing parallel circuits
(h) analysis
(i) equivalent circuits
(j) effects of open and short circuits

3. Series — Parallel
   (a) calculate total resistance
   (b) current division
   (c) voltage division
   (d) total power
   (e) analysis of series-parallel circuits
   (f) equivalent circuits
   (g) wheatstone bridge
   (h) Kirchoff's laws
   (i) calculate voltage to reference points
   (j) open and short circuits

D. Direct Current Meters **8 Hours**

1. Types
2. Construction
3. Measurement of current
4. Meter shunts
5. Voltmeters
6. Ohmmeters
7. Multimeters
8. Meter application

E. Conductors and Insulators **2 Hours**

1. Purpose
2. Types
3. Standard wire gauge sizes
4. Hardware
   (a) switches
   (b) fuses
   (c) pilot lamps, etc.
5. Wire resistance
6. Temperature coefficients
7. Ion current

8. Electron and hole charges in semi-conductors
9. Insulators

F. Resistors **2 Hours**

1. Types
2. Application
3. Color coding
4. Power rating
5. Tolerance
6. Selection for circuits
7. Resistor troubles

G. Batteries **4 Hours**

1. Function
2. Voltaic cell
3. Dry cell
4. Lead-acid cell
5. Specific gravity
6. Other cells
7. Internal resistance of batteries
8. Internal resistance of generators
9. Matching load resistance to generator

H. Magnetism **6 Hours**

1. The magnetic field
2. Magnetic flux
3. Flux density
4. Induction
5. Air gap
6. Types of magnets
7. Shielding
8. Permeability
9. Magnetic units
   (a) ampere — turns
   (b) field intensity

(c) Ohm's law of magnetic circuits
(d) hysteresis

I. Electromagnetic Induction

1. Magnetic field around a conductor of current
2. Coil polarity
3. Motor action
4. Induced current
5. Lenz' law
6. Induced voltage
7. Faraday's law

J. Alternating Current and Voltage

1. Alternating voltage generator
2. Sine wave
3. Voltage and current values for sine wave
4. Frequency
5. Period
6. Wave length
7. Phase
8. Time period of sine waves
9. Resistive AC circuits
10. 60 Hz line
11. Motors and generators
12. Nonsinusoidal waveforms
13. Harmonics

K. Inductance, Inductive Reactance and Inductive Circuits — 12 Hours

1. Induction by AC
2. Self-inductance
3. Self-induced voltage
4. How E_L opposes changes in current
5. Mutual inductance
6. Transformers
   (a) types of cores
   (b) core losses
   (c) types of transformers

7. Variable inductance
8. Coils in series and parallel
9. Stray inductance
10. Trouble in coils
11. Effect of E_L
12. $X_L = 2 \pi fL$
13. Inductors in series and parallel
14. Ohm's law applied to X_L
15. Application of X_L
16. Waveshape of E_L induced by sine wave current
17. E leads I by 90°
18. Resistance and reactance in series
19. Resistance and reactance in parallel
20. Quality of coils
21. AF and RF chokes
22. L/R time constant
23. High voltage produced by opening RL circuits
24. Comparison of resistance, inductive reactance and impedance

L. Capacitance, Capacitive Reactance and Capacitive Circuits 12 Hours

1. Storage of charge
2. Charge and discharge of capacitors
3. Unit of capacitance
4. Typical capacitors
5. Color coding
6. Capacitors in series and parallel
7. Stray capacitance
8. Troubles in capacitors
9. Energy in electrostatic field of capacitance
10. How AC voltage produces AC current in capacitive circuits
11. $X_C = \frac{1}{2 \pi fC}$
12. X_C in series and parallel

13. Ohm's law applied to X_C
14. Application of capacitive reactance
15. Charge and discharge current
16. I leads E by 90°
17. X_C in series and parallel circuits
18. Capacitive voltage dividers
19. Coupling capacitors
20. RC time constant
    (a) long
    (b) short
21. Universal time constant

M. Alternating Current Circuits **6 Hours**

1. AC resistive circuits
2. AC inductive circuits
3. AC capacitive circuits
4. Opposite reactances
5. Reactances and resistance in
   (a) series
   (b) parallel
6. Real and apparent power

N. Resonance **6 Hours**

1. The effect
2. Series resonance
3. Parallel resonance
4. Calculating frequency of resonance
5. Q — magnification
6. Bandwidth
7. Tuning and mistuning
8. Analysis of parallel resonant circuits
9. Damping of parallel resonant circuits
10. Choosing L and C for resonant circuits

SECTION TWO: BASIC ELECTRICITY — LAB 54 Hours

GENERAL OBJECTIVES:

1. To assist an apprentice in acquiring fundamental skills in proper and safe use of electrical bench equipment including test instruments by carrying out well planned shop activities.
2. To develop a basic understanding of d-c and a-c electric circuits and components.
3. To reinforce theoretical instruction by enabling the apprentice to gain practical circuit knowledge by performing meaningful assigned experiments.

A. Orientation

1. Laboratory rules and procedures
2. Bench kits and tools
3. Safety
4. Basic components and their symbols
5. Standard resistor color code
6. Schematic diagrams

B. Meters

1. Proper use and care
   (a) function and range switches
   (b) reading on different ranges
   (c) meter errors
   (d) safety precautions
2. Power supplies
   (a) operation
   (b) measuring terminal voltage

C. The Series Circuit

1. Line current
2. Voltage and voltage drop
3. Total resistance and total power
4. Application of Ohm and Kirchoff's laws

D. Parallel Circuits

1. Total resistance
2. Line current
3. Branch current
4. Voltage and voltage drop

5. Power and resistance characteristics
6. Application of Ohm and Kirchoff's laws

E. Series — Parallel Circuits

1. Current
   (a) total
   (b) branch
2. Voltage
   (a) applied and across each branch
   (b) across each component
3. Total resistance and total power
4. Checking resistors for open

F. Voltage Dividers

1. Characteristics
   (a) loaded
   (b) unloaded

G. Cells

1. Series
   (a) opposing
   (b) aiding
2. Parallel
3. Series — parallel
4. Care and application

H. Power Supplies

1. Internal resistance
2. Circuit efficiency
3. Maximum power transfer
4. Application

I. Wheatstone Bridge

1. Characteristics
2. Application

J. Meter Construction

1. Meter movement
   (a) arrangement
   (b) sensitivity
   (c) internal resistance
   (d) application

2. Ammeter shunts
3. Voltmeter multipliers
4. Ohmmeters
5. Multimeters

K. Cathode Ray Oscilloscope

1. Function, use and care
2. Operation
3. Application
   (a) measuring voltage
   (b) time
   (c) measuring frequency
   (d) phase measurement

L. Alternating Current and Voltage

1. Sine wave
   (a) peak value
   (b) RMS value
   (c) cycle
   (d) frequency
   (e) wavelength
2. Angular measurement
3. Radian measure
4. Phase angle

M. Inductance (Coils) and Inductive Reactance

1. Effect of inductance on current in DC and AC circuits
2. Measurement of X_L
3. Verify that $X_L = 2 \pi fL$
4. Back EMF
5. Phase relations between I and E inductive circuits
6. Open coil
7. Resistance of coil
8. L/R time constant

N. Capacitors, Capacitance and Capacitive Reactance

1. Determining value of capacitors
2. Effect of capacitance on current in DC and AC circuits
3. Measurement of X_C

4. Verify that $X_C = \frac{1}{2 \pi fc}$
5. Phase relations between I and E in capacitive circuits
6. RC time constant
7. Capacitors in series and parallel
8. Open and shorted capacitors

O. Series RLC Circuits

1. Current and voltage
2. Verify the $Z = \sqrt{R^2 + (X_L - X_C)^2}$
3. Series resonance
   (a) $fr = \frac{1}{2 \pi \sqrt{LC}}$
   (b) line current
   (c) impedance and voltage
   (d) other characteristics
   (e) application

P. Parallel RLC Circuits

1. Current and voltage
2. Impedance (Z)
3. Parallel resonance
   (a) line current
   (b) impedance and voltage
   (c) other characteristics
   (d) application

SECTION THREE: TRADE MATHEMATICS 42 Hours

A. Review of Basic Arithmetic

1. Common fractions
2. Decimal fractions
3. Percentage
4. Factoring
5. Ratio and proportion

B. D.C. Series Circuit Problems

1. Power of ten
   (a) scientific notation
      (i) multiply

(ii) divide
(iii) raise to a power
(iv) add and subtract

(b) electronic calculator

2. E = IR and its variations
3. P = IE and its variations
4. Formula manipulation
5. Multi-resistor series circuits
6. Internal source resistance

C. D.C. Parallel and Series-Parallel Circuit Problems

1. Parallel circuits
   (a) application of Ohm and Kirchoff's laws
   (b) power calculations
2. Series — Parallel circuits
   (a) application of Ohm and Kirchoff's laws
   (b) power calculations
3. Voltage divider problems
4. Wheatstone bridge problems

D. Trigonometric Functions

1. Properties of a right angle triangle
2. Trigonometric ratios
   (a) sine
   (b) cosine
   (c) tangent
3. Solution of right angle triangles
4. Trigonometric solution of A.C. circuits
   (a) voltage
   (b) current
   (c) phase angle
   (d) power
   (e) impedance

E. Series AC Circuit Problems

1. Resistive
2. Inductive
3. Capacitive
4. RL, RC and LRC
5. Power

6. Resonance
7. Time constant (RL and RC)

F. Parallel AC Circuit Problems

1. Resistive
2. Inductive
3. Capacitive
4. RL, RC and LRC
5. Power
6. Resonance

SECOND PERIOD TECHNICAL TRAINING

SECTION ONE: ELECTRONIC THEORY **54 Hours**

A. Review of Prerequisites **4 Hours**

1. Ohm's law
2. Impedance R, X_L
3. Current and voltage sources
4. Thevenin's theorem

B. Semi-Conductor Physics

1. Atomic structure of atoms
2. Crystals
3. Doping

C. PN Junction

1. Forward bias
2. Reverse bias
3. Leakage current

D. Diodes **8 Hours**

1. The rectifier diode
2. Diode curve
3. Bulk resistance
4. Reverse resistance
5. Zener diode
6. Breakdown voltage and peak inverse voltage

E. Power Supplies (Block Diagrams)

1. Rectifiers
2. Filters
3. Voltage regulators

F. Junction Transistors **5 Hours**

1. Transistor theory and correct biasing
2. Symbols

3. Current relationship
   (a) alpha
   (b) beta
4. Cut off current, breakdown voltage and collector saturation voltage

G. Transistor Biasing **9 Hours**

1. Base bias
2. Emitter bias
3. Collector feedback bias
4. Collector cutoff current

H. Small Signal Amplifiers **8 Hours**

1. Current gain and voltage gain of amplifiers
2. Base driven amplifiers
3. Emitter driven amplifiers
4. Comparisons between the three types of configurations
   (a) common emitter (CE)
   (b) common collector (CC)
   (c) common base (CB)

I. Power Amplifiers **6 Hours**

1. Operating point
2. Single ended power amplifier
3. Push-pull amplifier

J. Oscillators **2 Hours**

1. Theory of operation
2. Types of oscillators
   (a) RC phase shift
   (b) Wien-bridge
   (c) Hartley
   (d) Colpitts
   (e) Crystal

K. Metal-Oxide Semiconductor Fet (Mosfet) **3 Hours**

1. Construction
2. Operation
3. Application, e.g. common source amplifier

L. IC Operational Amplifier **8 Hours**

1. Integrated circuit PNP and NPN transistors
2. Dual transistors
3. Differential amplifiers
4. Ideal operational amplifiers
5. Analysis of operational ampliers
6. Circuits (block diagrams)
   (a) the comparator
   (b) the voltage follower
   (c) inverting amplifier
   (d) the non-inverting amplifier
   (e) the summing amplifier
   (f) the subtracting amplifier
   (g) the active filter

M. Clipping Circuits **1 Hour**

1. Diode clipper
2. Transistor clipper

SECTION TWO: ELECTRONIC LAB **18 Hours**

A. Lab Familiarization Activities **1 Hour**

1. Orientation
2. Procedures
3. Proper use of test equipment
4. Safety

B. Power Supplies **5 Hours**

1. Construction of a full wave power supply with various types of filters and using zener diodes for regulation
2. Measuring DC output and ripple
3. Relating lab observations to theoretical explanations

C. Transistor Circuit Familiarization **2 Hours**

1. Recognizing different transistor biasing arrangements
2. Perform "Go-No-Go" checks on the transistor using VOM
3. Determining whether a transistor is NPN or PNP using a VOM
4. Identifying transistor terminals using a VOM

D. Common Emitter Amplifier **4 Hours**

1. Measuring voltage gain
2. Phase relations between input and output voltages
3. Measuring input and output impedance
4. Troubleshooting common emitter amplifiers by comparing calculated and measured values

E. Oscillator Circuits **2 Hours**

1. Construction of an oscillator circuit
2. Calculation and measurement of oscillator frequency

F. Operational Amplifiers **4 Hours**

1. Construct an operational amplifier
2. Calculate and measure the gain of an operational amplifier
3. Study feedback effect
4. RC active filter

SECTION THREE: BASIC TELEPHONY **54 Hours**

A. Basic Telephone Set **3 Hours**

1. Basic components, their symbols and theory of operation
   (a) transmitter
   (b) receiver
   (c) rotary dial
   (d) touch-tone dial
   (e) hookswitch
   (f) ringer and capacitor
      (i) metallic
      (ii) ground
   (g) network
      (i) sidetone
      (ii) anti-sidetone
   (h) terminals

B. Telephone Type **3 Hours**

1. Circuit analysis and comparison of:
   (a) N.E. Co. 500 telephone
   (b) N.E. Co. 554 FRN set
2. Station Protection
   (a) protectors
   (b) grounding

3. Line characteristics
   (a) line voltage
   (b) line current
   (c) ringing voltage

C. Telecommunication Systems **2 Hours**

1. The North American Network
   (a) intraoffice calls
   (b) interoffice calls
      (i) local
      (ii) long distance
   (c) North American numbering scheme
   (d) North American switched network
      (i) 5 classes of office
      (ii) define: 2 and 4 wire switch

2. Block diagram of telecommunication system **3 Hours**
   (a) subscriber station equipment
      (i) telephone sets
      (ii) key equipment
      (iii) PABX
   (b) telephone switching system
      (i) eight basic functions of switching
      (ii) progressive control system
      (iii) electromechanical common control system
   (c) mutiplex systems
      (i) carriers
      (ii) coaxial carriers
   (d) radio systems
      (i) HF and VF
      (ii) microwave
      (iii) satellite
   (e) fiber optic transmission system

D. Relays General **6 Hours**

1. Definition and theory of operation
   (a) operate current
   (b) non operate
   (c) release, etc.

2. Relay parts and terminology
   (a) relay contact operations
   (b) types of materials for contacts
   (c) relay windings
      (i) same direction
      (ii) differential
      (iii) non-inductive

3. Relay types
   (a) wire spring
      (i) use
      (ii) contact arrangement
   (b) miniature relays
      (i) use
      (ii) contact arrangement
   (c) Reed relays
      (i) use
      (ii) contact arrangement

E. Print Reading

1. Review of schematic symbols **2 Hours**
2. Sectionalized detached schematic (SAI) **6 Hours**
   (a) index
   (b) F.S.
   (c) apparatus figures
   (d) notes
   (e) sequence charts
   (f) circuit arrangements tables
   (g) cabs
3. Transistor — CKT prints **4 Hours**
4. Attached non-sectionalized (WESCOM)
5. Electronic Key System prints (CK530) **2 Hours**

F. Battery, Ringing and Tone Supplies **3 Hours**

1. Talk and signal battery
2. Tone supplies
   (a) dial tone
   (b) high, low, class of service tones
   (c) line busy
   (d) all trunks busy
   (e) coin tones
   (f) recorder warning
3. Ringing and ring back schemes
   (a) urban
   (b) rural
4. Measuring and identifying tones (Lab)

G. Basic Switching System Functions **2 Hours**

1. Interconnecting
2. Control
   (a) connect and disconnect
   (b) answer and hang-up

3. Alerting
4. Attending
5. Information receiving
6. Information transmitting
7. Busy testing
8. Supervision
9. Illustration of each function using SA1 type office

H. Introduction to Key Equipment **6 Hours**

1. History
2. Block diagram of CK530
   (a) function of cards
3. Concepts of electronic key systems
   (a) vantage 12
   (b) NEC
   (c) Tie

BASIC TELEPHONE LAB **12 Hours**

A. Telephone Trouble Shooting

1. Type 554
2. Type 500

B. Relay Jobs

1. Troubleshooting using prints and wire spring relays

SECTION THREE: LOGIC **48 Hours**
(THEORY – 36 Hours, LAB – 12 Hours)

A. Number Systems **4 Hours**

1. Study of decimal system as an introduction to:
   (a) binary
   (b) binary coded decimal
   (c) octal
   (d) hexadecimal
   (e) other codes, i.e. ASCII, EBCDIC

B. Basic Logic Circuits **4 Hours**

1. Introduction to Boolean Algebra
2. AND, OR, NOT

3. Truth tables
4. Simple multilevel functions
5. Simple logic circuits
   (a) AND
   (b) NOR
   (c) NOT
   (d) 2/3 level
6. Universal logic
   (a) NAND
   (b) NOR
   (c) realization of multi-level functions

C. Flip Flops **6 Hours**

1. S-R NAND circuit study
2. D type NAND circuit study
3. J-K MSI version — external characteristics
4. Applications of J-K, i.e. D flip flop, T flip flop, etc.

D. Counters, Encoders, Registers **6 Hours**

1. Counters, synchronous, asynchronous
   (a) simple binary counter
   (b) MSI counter circuits
2. Encoders
   (a) decimal to binary and BCD
   (b) binary, BCD to decimal
   (c) MSI coder circuits
3. Registers
   (a) serial in serial out
   (b) serial in parallel out
   (c) parallel in serial out
   (d) parallel in parallel out

E. Memory **2 Hours**

1. Principles of semi-conductor memory
2. Magnetic tape principles

F. Other Devices **8 Hours**

1. Astable multivibrators
2. Monostable multivibrators
3. Schmitt trigger
4. Timers

5. Display devices
   (a) 7 segment
   (b) led
6. Optical couplers
7. Trisate logic
8. Buffers

G. Lab Familiarization Activities **12 Hours**

1. Orientation
2. Procedures
3. Proper use of test equipment
4. Safety, etc.

H. Combinational Circuits

1. Build several simple NAND circuits and test for operation

I. Flip Flops

1. Build and test RS and D type flip flops using NAND gates
2. Test MSI J-K flip flop

J. MSI Logic Chips

1. Check the operation of a counter and decoder considered in theory

THIRD PERIOD TECHNICAL TRAINING

SECTION ONE: MICROPROCESSOR AND MINICOMPUTER CONCEPTS **72 Hours**

A. Basic Review of Logic

1. Terms and conventions
2. Number systems and codes
   (a) binary, octal and hexadecimal and decimal numbering systems
   (b) conversions
3. Logic and hardware basics
   (a) basic logic gates
   (b) truth tables
   (c) logic symbols
   (d) types of registers
   (e) flip-flops

B. Computer Arithmetic

1. Addition and Subtraction
   (a) binary
   (b) hexadecimal

C. System Overview of Computers — 2 Hours

1. Types
2. Differences
3. Definition
4. Major components
5. Capabilities and limitations

D. Main Memory — 4 Hours

1. Functional description of core and semiconductor memories
2. Interleaving concepts
3. Read only memory
4. Cache memory
5. RAM

E. Central Processor

1. Major components
2. Arithmetic — logic
3. Major registers and functions

4. Typical instruction cycles
5. Use on console

F. Instruction Sets (including lab) **20 Hours**

1. Instruction format
2. Addressing techniques
3. Typical instruction sets
4. Development of simple programs using instruction sets

G. Bus Structures **2 Hours**

1. Typical bus configuration
2. Serial versus parallel transfers
3. Major functions of interfaces
4. Interrupt levels

H. Input/Output Techniques (including lab) **10 Hours**

1. Programmed data transfer
2. Program interrupts
3. Priority techniques
   (a) polling tables
   (b) multiple interrupt lines
4. Direct memory access and transfer
5. Channel input/output

I. File Organization **2 Hours**

1. Types of file organization
   (a) sequential files
   (b) random access
   (c) index sequential access
   (d) simple list organization

J. Operating Systems **6 Hours**

1. Developing programs using tape software
2. Parts of an operating system
3. Batch and time sharing operating systems
4. Real-time operating systems

K. General Software **4 Hours**

1. Process of assembly
2. Comparison of high and low level language

L. Languages **4 Hours**

1. Sub-routines
2. Absolute and relocatable assemblies
3. MACRO instruction
4. Compilers and interpreters
5. Comparison of basic to PL/1 and ALGOL

M. Peripheral Devices **7 Hours**

1. Survey of peripherals
   (a) TTY
   (b) video terminals

SECTION TWO: COMMON CONTROL PRINCIPLES **108 Hours**
(THEORY – 78 Hours, LAB – 30 Hours)

A. Introduction to Common Control **3 Hours**

1. Comparison of direct progressive control with electromechanical common control and stored program common control.
   (a) class of service
   (b) double connection
   (c) new features
   (d) maintenance
   (e) traffic

B. Switching Network Devices **5 Hours**

1. Crossbar switch — mini bar
   (a) mechanical operation
   (b) electrical operation
   (c) modifications to change ratio
   (d) control
2. Crosspoint
   (a) mechanical operation
   (b) electrical operation
3. Reed switches
   (a) mechanical operation
      (i) latching
      (ii) non-latching
   (b) electrical operation
      (i) latching
      (ii) non-latching

C. Switching Network Principles **4 Hours**

1. Build-out networks

2. Multi-stage networks
    (i) two stage network
    (ii) three stage network
    (iii) four stage network

D. Control Circuits **2 Hours**

1. Wired program control
2. Stored program control
3. Control by function
    (i) dial tone markers
    (ii) call completing markers

E. Study of Switching Systems

1. Wired program common control (using SA-1 as a medium) **32 Hours**
    (a) detail description
        (i) network layout
        (ii) registers
        (iii) controller
        (iv) trunking
        (v) dial tone
        (vi) local call (IAO)
    (b) block diagram concept
        (i) revertive call
        (ii) incoming call
        (iii) outgoing call
2. Stored program common control (using SP-1 as a medium) **32 Hours**
    (a) features made available by software
    (b) detail description
        (i) central control complex
            — central processing unit
            — memories
            — maintenance centre
        (ii) peripheral equipment
            — bus
            — scanner
            — marker
            — signal distributor
        (iii) network
            — line link network
            — service link network
            — route link network
            — originating and terminating junctions
            — trunk and service circuits
        (iv) call processing block diagrams
            — introduction to switching software
            — dial tone connection
            — intraoffice call
            — interoffice call

FOURTH PERIOD TECHNICAL TRAINING

SECTION ONE: TRANSMISSION **54 Hours**
(THEORY – 36 Hours, LAB – 18 Hours)

A. Decibels **6 Hours**

1. Logs, dB, dBm
2. dB meters
3. Level measurements
   (a) dB
   (b) loss
   (c) level points

B. Message Channel Objectives **2 Hours**

1. Purpose of transmission system
2. Objectives in reference to
   (a) level
   (b) distortion
   (c) crosstalk
   (d) echo and singing
   (e) noise
   (f) expectation of customer

C. Speech and Hearing **2 Hours**

1. Energy distribution
2. Normal receive level at telephone receiver
3. Hearing is on logarithmic basis

D. Telephone Set — Type 500 **1 Hour**

1. From the transmission point of view only

E. Types of Messages **2 Hours**

1. Speech
2. Data
3. Video

F. Types of Facilities **2 Hours**

1. Paired cable
2. Coaxial cable
3. Multiplex and radio
4. Open wire

5. Wave guide
6. Fiber optics

G. Attenuators **5 Hours**

1. Purpose
2. Types (T, PI, L Square, H pads)
3. Characteristic impedance and loss

H. Transmission Lines **10 Hours**

1. Characteristic impedance and why it is important to know
2. Characteristic impedance depends on R, L, C and G called primary constants
3. Reflection
   (a) cause and effect
   (b) how to reduce
4. Lab job on transmission characteristics using artificial line

I. Equalization (Amplitude and Delay) **2 Hours**

1. What is it
2. When is it used

J. Loading **4 Hours**

1. Why is it used
2. Coil spacing and build out capacitors
3. Used for VF
4. Two end sections and impedance compensators

K. Hybrid Circuits **2 Hours**

1. Types
2. Purpose of each type
3. Operation of transformer hybrid

L. Four Wire Termination Sets **5 Hours**

1. Function
2. Most important design feature (separate receive from transmit)
3. Insertion loss, hybrid loss, trans-hybrid loss
4. Return loss, ERL, SRL
5. Singing

6. Standard test tone levels
7. Balancing network

M. Noise **4 Hours**

1. Types and causes (use lab demonstrations)
2. Interfering effect on speech and data
3. Noise units
4. Noise meter
5. Example of noise measurement, e.g. idle noise

N. General Toll Switching Plan **1 Hour**

1. Toll connecting trunks
2. Intertoll trunks
3. High usage and final route trunks

O. Via Net Loss (Terminology)

P. Loop Design **3 Hours**

1. Loop resistance for switching offices
2. Cable gauges
3. Loop losses
4. Interoffice trunks
5. Loading and repeaters
6. DC resistance

Q. Circuit Layout **1 Hour**

1. VF circuit layout
2. Toll circuit layout
3. VF interoffice trunk layout

R. Principles of FDM Carrier System (block diagram treatment) **2 Hours**

1. Modulators
2. Filters
3. Connections to trunks, 4 WTS, radio
4. Signalling

SECTION TWO: ADVANCED SWITCHING **126 Hours**

A. Digital Switching Concepts **72 Hours**

1. Space switching (concepts) **2 Hours**
   (a) description
   (b) limitations
   (c) alternative methods

2. Time switching (concepts) **6 Hours**
   (a) description
   (b) limitations
   (c) types

3. PCM concepts **6 Hours**
   (a) sample
   (b) quantize
   (c) code
   (d) frames
      (i) CCITT
      (ii) AT and T

4. Digital concentration stage (local and remote) **4 Hours**
   (a) functions and assembly
      (i) live circuit
      (ii) switching network
      (iii) scanner
      (iv) control memory
      (v) signalling

5. Digital distribution stage **4 Hours**
   (a) switching in time and through time
   (b) space switching of PCM highways
   (c) PCM network configurations
      (i) TST
      (ii) STS
      (iii) other combinations of time and space
      (iv) serial to parallel conversion
         — effects of the distribution stage

6. Synchronization **6 Hours**
   (a) data flow
   (b) types of clocks
   (c) elastic buffers
   (d) FIFO
   (e) clock control

7. Digital service circuits **2 Hours**
   (a) tone source
   (b) tone receiver
   (c) conference

8. Comparison and identification of systems **4 Hours**
   (a) DMS-1 and other remote concentrators
      (i) block diagram
      (ii) switching network
      (iii) control
   (b) DMS 10 (using the SL-1 as the medium) **21 Hours**
      (i) block diagram
      (ii) switching network
      (iii) control
      (iv) other class 5 offices (DMS 100)
   (c) higher class digital switchers (DMS 200/300, #3EAX) **15 Hours**
      (i) block diagram
      (ii) switching network
      (iii) control

9. Introduction to basic concepts of CCIS **2 Hours**

B. PCM Cable Carrier Concepts **54 Hours**

1. PCM concepts **12 Hours**
   (a) sampling and sampling theorem
   (b) pulse amplitude modulation — 24 Channels
      (i) calculation of time duration
   (c) conversion of input signal to PCM
      (i) sampling function
      (ii) quantizing function
      (iii) encoding function
   (d) regeneration
   (e) advantages of PCM transmission
   (f) a simple PCM system
      (i) TX channel unit — sampling function
      (ii) TX common equipment unit — quantizing and encoding function
      (iii) line repeater units — regeneration function
      (iv) RX common equipment unit — decoding function
      (v) RX channel unit — V.F. reconstruction
   (g) quantization noise and PCM companding
      (i) quantizing and quantizing noise
      (ii) compromising between noise and bandwidth
      (iii) PCM compandors
      (iv) the compression characteristic curve — S/N improvement over dynamic input range
   (h) PCM encoding methods
      (i) non folded binary code
      (ii) folded binary code
      (iii) advantages of a folded binary code
      (iv) encode PAM samples to binary examples
      (v) zero code suppression — reason

(i) the compression characteristics curve
  (i) compression requirements
    — improved S/N ratio
    — constant S/N ratio over wide-input range
  (ii) the — law curve
  (iii) D2/D3 CODEX ($\mu = 255$)
  (iv) non-uniform codec transfer characteristic
  (v) straight line approximations of compression characteristic curve
    — sign — step — segment
  (vi) evaluating levels on the compression characteristic curve — examples using PAM samples
  (vii) linearizing the PCM code
(j) PCM frame format
  (i) 8 bit voice encoding — 5 of 6 frames
  (ii) 7 bit voice encoding — 1 of 6 frames
  (iii) "193" S big position
  (iv) calculation of PCM bit rate
(k) signalling and framing identification
  (i) S-bit pattern — 24 channel system
  (ii) SYNC pattern — terminal framing
  (iii) signalling identification pattern
  (iv) A & B signalling channels

2. Digital timing and synchronization **5 Hours**
(a) transmit and receive paths through common equipment units
(b) DSI timing
  (i) 1.544 master oscillator
  (ii) transmit and receive digit counters
  (iii) transmit and receive channel counters
(c) receive synchronization
  (i) receive framing logic
  (iii) receive signalling frame identification (A or B)
  (iii) out of frame detector
    — waveforms
  (iv) bit 2 detector — remote alarm
  (v) loss of synchronization
    — resulting sequence of events
(d) terminal alarms
  (i) local alarm: loss of PCM, loss of synchronization, loss of power
  (ii) remote alarm: loss of bit 2
  (iii) power alarm
  (iv) system alarm — office alarms

3. Digital multiplexing **4 Hours**
(a) hierarchy of digital transmission
(b) DM 12
  (i) bits (number and identification)
    — sub-frame
    — master frame
    — DS — 2 bit stream

(ii) sampling sequence DS — 2 inputs
— relationship of the control bits for a sub-frame of a DS-2 signal
(iii) C bit pattern
— stuffing
— DS — 2 signal

(c) DM 23
(i) bits (number and identification)
— sub-frame
— master frame
— control bits of DS — 3 signal
(ii) sampling sequence of DS — 2 inputs
— relationship of control bits for main frame of DS — 3 signal

(d) DM 34
(i) bits (number and identification)
— sub-frame
— main frame
— control bits of main frame of a DS — 4 signal
(ii) sampling sequence of DS — 3
— relationship of control bits of a main frame of a DS — signal
(iii) C bit pattern
— stuffing
— DS — 4 signal

4. T1 repeatered line considerations **4 Hours**

(a) T1 line signal
(i) characteristics
(ii) advantages of bipolar transmission

(b) distances between line repeaters nominally
(i) loss between repeaters
(ii) maximum number of repeaters per system

(c) types of cable used
(i) unscreened cable — exchange carrier applications
— effects of NEXT (Near End Crosstalk)
(ii) screened cable — toll quality carrier — advantages
(iii) cable gauge and location
(iv) no loading on PCM cables

(d) definition of "SPAN" and "SPAN LINE"
(i) through offices

(e) simplex powering — function

(f) PCM order wire — function — type of loading

(g) PCM fault locating — function — type of loading

5. Repeatered line equipment **6 Hours**

(a) line repeaters
(i) reshaping (ALBO — equalization)
(ii) retiming
(iii) regeneration

(b) repeater housings
  (i) types — Lenkurt and Vicom housings
  (ii) pressurization
  (iii) methods of mounting (and installation)
  (iv) order — wire connection
  (v) number of repeaters per unit
  (vi) fault locate filter
  (vii) lightning protection
(c) span line office terminating equipment
  (i) office terminating repeater
  (ii) simplex power unit
  (iii) office fault locate filter unit
  (iv) spare line switching equipment

6. PCM line fault locating **5 Hours**
(a) concept — fault identification
(b) interrogation signal — audio components
(c) methods of fault location — frequencies
  (i) basic single interrogation system
  (ii) looped interrogation systems
  (iii) use of multiple fault locate pairs
  (iv) use of amplifiers with fault locate filters
  (v) the office fault locate unit
  (vi) the line fault locate unit

7. Digital test sets **2 Hours**
(a) span and repeater test sets
  (i) fault locating tests
  (ii) repeater tests
  (iii) span line tests

8. Protection switching **2 Hours**
(a) definition
(b) types of systems
(c) reasons for switching to spare facilities

9. Network concepts **2 Hours**
(a) describe digital mode of communication
  (i) subscriber carrier
  (ii) subscriber switching
  (iii) subscriber radio
  (iv) light route carrier
  (v) heavy route carrier
  (vi) radio
  (vii) W.L.E.L.
  (viii) fiber optics
  (ix) coaxial

10. Fiber optics **12 Hours**
(a) basic concepts of fiber optic transmission systems
  (i) definition
  (ii) historical review
  (iii) basic operation

(b) types of fiber
    (i) step index multimode
    (ii) graded index multimode
    (iii) step index singlemode
    (iv) fiber manufacture
(c) fiber parameters
    (i) numerical aperture
    (ii) dispersion
        — modal
        — chromatic
        — material
    (iii) attenuation
(d) light sources
    (i) characteristics of LED and LASER LIGHT
        — time and space coherence
        — collimation
        — power density
        — stable waveform characteristics
        — spectral width
    (ii) laser physics
    (iii) comparison of LED and LASER DIODES
(e) photo detectors
    (i) basic mechanism of photodetection
    (ii) responsivity of optical detectors
    (iii) PIN and AVALANCHE PHOTO DIODE (APD) — parameters values
(f) modulation and multiplexing
    (i) modulation
    (ii) "FOTS" equivalent "T" hierarchy
    (iii) multiplexing
        — time division multiplexing (TDM)
        — wavelength division multiplexing (WDM)
        — space division multiplexing (SDM)

SUGGESTED REFERENCE MATERIALS

Basic Electronics — Grob — McGraw Hill — 5th Edition

Basic Mathematics for Electronics — Cook and Adams — 4th Edition

Basic Telephone Switching Systems — Talley —
Hayden Book Company — 1969

Principles of Electricity Applied to Telephone and Telegraph Work —
A.T. & T. Co. — 1961 Edition

Transmission for Telecommunications — Clarke — SAIT Publication

Telephone Principles — TXT 222 — SAIT Publication

Elementary Communications — NAIT Publication

Electronic Principles — Malvino — McGraw Hill — 2nd Edition

Microprocessors and Minicomputers Hardware and Software —
Tocci — Prentice Hall

Digital Principles and Applications — Malvino/Leach —
McGraw Hill — 2nd Edition

TECHNICAL TRAINING SCHOOLS

The Communication Electrician apprenticeship training program is offered by Alberta Manpower, Apprenticeship and Trade Certification Division. Staff and facilities for teaching the program are supplied by:

1. Northern Alberta Institute of Technology
2. Southern Alberta Institute of Technology

LOCATION OF APPRENTICESHIP AND TRADE CERTIFICATION DIVISION REGIONAL OFFICES

BONNYVILLE

CALGARY

EDMONTON

FORT McMURRAY

GRANDE PRAIRIE

HINTON

LETHBRIDGE

MEDICINE HAT

PEACE RIVER

RED DEER

VERMILION

GOVERNMENT OF THE PROVINCE OF ALBERTA

ALBERTA REGULATION 93/80

(Filed on March 14, 1980)

THE MANPOWER DEVELOPMENT ACT

DEPARTMENT OF ADVANCED EDUCATION AND MANPOWER

MINISTERIAL ORDER

I, James D. Horsman, Minister of Advanced Education and Manpower, pursuant to sections 30(2) and 37(2) of The Manpower Development Act, hereby make regulations in the Appendix attached hereto, being the Communication Electrician Trade Regulation.

Dated at the City of Edmonton, in the Province of Alberta, this 12th day of March, 1980.

JAMES D. HORSMAN,
Minister of Advanced Education and Manpower.

APPENDIX

THE MANPOWER DEVELOPMENT ACT

Communication Electrician Trade Regulation

1(1) In this regulation

(a) "communication electrician" means a person engaged in the construction, installation and maintenance of telecommunication systems;

(b) "General Regulations" means the General Regulations under The Manpower Development Act, (Alta. Reg. 43/77) as amended;

(c) "trade" means the trade of communication electrician.

(2) The definitions in the General Regulations apply in this regulation.

Part 1

APPRENTICESHIP AND TRADE TRAINING

2 A person is eligible to be an apprentice who has

(a) satisfied the requirements of section 5 of the General Regulations, and

(b) completed grade 11 with Mathematics 20 or its equivalent, or passed an entrance examination prescribed by the Board.

3(1) Subject to subsection (2), an employer who is a journeyman or employs a journeyman may employ one apprentice, and for each additional journeyman he employs, he may employ one additional apprentice.

(2) The Director may authorize an employer to employ an apprentice, in addition to those permitted under subsection (1), on a temporary basis, to train him in a branch of the trade not engaged in by the employer to whom he is apprenticed.

(3) An apprentice employed temporarily under subsection (2) shall not, for the purposes of subsection (1), be considered to be an apprentice of his temporary employer.

4(1) The term of apprenticeship shall consist of four periods of 12 months each.

(2) Each period referred to in subsection (1) shall consist of not less than 1800 hours of on the job training, inclusive of time spent attending technical courses prescribed by the Board.

(3) The Director may not, under section 25(1) of the Act, reduce the term of apprenticeship to be served by an apprentice to less than one period of apprenticeship.

5 When a contract of apprenticeship is registered with the Director, he shall issue to the apprentice an official record book referred to in section 14 of the General Regulations.

6(1) An apprentice shall not advance to the next period until the Director has authorized him to do so by making an entry in the apprentice's official record book under subsection (2).

(2) The Director shall make an entry in the apprentice's official record book authorizing advancement to the next period, when the apprentice

(a) has completed the previous period of apprenticeship,

(b) has received, in the opinion of the Director, a satisfactory report from

(i) his employer, and

(ii) the school at which he attended technical training courses prescribed by the Board,

(c) has completed the tests and examinations prescribed by the Board, and

(d) has attained pass marks prescribed by the Board, in the tests and examinations referred to in clause (c).

7 The official record book of an apprentice shall be kept in the possession of his employer and, upon termination of employment of the apprentice, the employer shall present the book to him.

8(1) An employer shall pay wages to the apprentice that are not less than the following percentages of the prevailing wages paid to a journeyman:

(a) 40% in the first period;

(b) 50% in the second period;

(c) 60% in the third period;

(d) 75% in the fourth period.

(2) Notwithstanding subsection (1), the wages paid to an apprentice shall not be less than the minimum wage fixed pursuant to The Alberta Labour Act, 1973.

(3) An employer is not required to pay an apprentice wages during the time that the apprentice spends attending technical training courses prescribed by the Board.

9 The hours of work and working conditions of an apprentice shall be the same as those of a journeyman.

Part 2

CERTIFICATION

10 In addition to section 32 of the General Regulations, the Director may issue a Certificate of Qualification for the trade of communication electrician without examination to a person who holds

(a) a Certificate of Completion of Apprenticeship in the trade issued by another province within Canada, or

(b) a Certificate of Qualification or a Certificate of Proficiency in this trade issued by another province within Canada bearing an Interprovincial Standards Red Seal.

11(1) An application to take an examination for a Certificate of Qualification shall be made to the Director.

(2) Documentary evidence acceptable to the Director shall be presented by an applicant for an examination showing that the applicant

(a) holds a certificate equivalent to an Alberta Certificate of Qualification issued by a recognized provincial authority outside of Alberta, or

(b) has at least 4 years of acceptable work experience in the trade.

(3) The applicant shall provide translations into the English language, acceptable to the Director, of credentials other than in English submitted pursuant to subsection (2).

12 Certificates of Qualification issued under this regulation are effective unless cancelled or suspended by the Director in accordance with sections 42 and 43 of the General Regulations.

13 Alberta Regulation 570/64 is repealed.